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Date of request 6/14/96 ~~[illegible]~~ ~~3/[illegible]/96~~ Expected receipt of document 7/14/96 ~~[illegible]~~ ~~[illegible]~~

Document number ________ Date of document 1960

Title and author (if document is unnumbered) (7 items)

Radiation Protection Criteria and Standards: Use at UCC Facilities.

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(This section to be completed by Document Center)

Date request received 6/19/96

Date submitted to ADC 7/11/96

Date submitted to HSA Coordinator 6/19/96

(This section to be completed by HSA Coordinator)

Date submitted to CICO 7/11/96

Date received from CICO 7/15/96

Date submitted to ChemRisk/Shonka and DOE 7/16/96

(This section to be completed by ChemRisk/Shonka Research Associates, Inc.)

Date document received

Signature

#3290

cc: Jennifer Lamb

cc/encl: Steve Wiley
Linda Hill
See release 7/11/96

cc w/enc: Linda Hill - Item 1
Steve Wiley - Item 5; Item 2 which contains multisite information must be reviewed for classification by K-25 and ORNL, PGDP, and Y-12--Y-12 will be responsible for release of document after all classification reviews are completed
Sheila Thornton - Items 4, 6, and 7
Sheila Thornton - Item 3 (PGDP document to be sent to PGDP for release)

cc: Jennifer Lamb - For your information

Item 1 - ORNL Document
Item 2 - Y-12 Document which contains multisite information requiring classification review by K-25, ORNL, PGDP, and Y-12
Item 3 - PGDP Document
Item 4 - K-25 Document
Item 5 - Y-12 Document
Item 6 - K-25 Document
Item 7 - K-25 Document

SG Thornton
7/11/96

RADIATION PROTECTION CRITERIA AND STANDARDS, THEIR BASIS AND USES AT ATOMIC ENERGY FACILITIES OPERATED BY UNION CARBIDE CORPORATION

by Clark E. Center
Vice President, Union Carbide Nuclear Company

PART I. OVER-ALL ACTIVITIES

INTRODUCTION

This is a brief summary review of the radiation protection practices at the production and laboratory facilities operated by the Union Carbide Corporation for the Atomic Energy Commission, with particular reference to use of applicable standards. This Corporation is one of the oldest and largest of the AEC contractors, having operated continuously since 1943, and presently employs over 15,000 people in its contractor operations.

In the production operations, uranium materials are enriched in the uranium-235 isotope and this product is subsequently processed for designated uses; these activities are carried out in the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant at Oak Ridge, Tennessee, and in the Paducah Gaseous Diffusion Plant at Paducah, Kentucky. The Oak Ridge National Laboratory is engaged in extensive basic and applied research programs producing and using a wide variety of atomic materials. Practically every type of radiation hazard in the atomic energy industry exists to a greater or less extent in the Union Carbide operations, and the protection of employees has always been a recognized policy of the Corporation.

Radiation protection at the Oak Ridge National Laboratory

Union Carbide Nuclear Company, Oak Ridge Gaseous Diffusion Plant, Operating Contractor for the U.S. Atomic Energy Commission.

includes consideration of various research and pilot plant reactor operations as well as other experimental work involving radioactive materials, primarily beta-gamma emitters. In addition to the necessity for personnel protection at the laboratory itself, significant efforts are also necessary for adequate disposal of radioactive wastes to meet applicable criteria for protection of the general plant environs.

In production operations, uranium enters as a purified uranium oxide which, through several processing steps, is fluorinated to UF_6. This gaseous material is then passed through the complex of gaseous diffusion cascades wherein it is enriched in the U-235 isotope. This U-235-enriched uranium is then processed into various forms of finished materials, including oxides and metals, for appropriate usage.

Routine considerations of radiation protection at these production plants are thus primarily concerned with the possibility of internal exposure from the alpha-emitting uranium. However, there is also the possibility that high levels of penetrating radiation can result from an accidental critical mass excursion, and there are comparatively minor considerations of routine exposure to beta-gamma radiation from uranium daughters and from trace quantities of other radioactive isotopes encountered in the reprocessing of uranium from the spent fuel of various power and production reactors. Waste disposal and environmental protection, although carefully and adequately controlled, represent comparatively minor portions of the over-all control programs.

STANDARDS

The permissible radiation exposure limits used are those established by the National Committee on Radiation Protection as given primarily in NBS Handbooks 59 for external exposure and 69 for internal exposure. These specify standards for internal body deposition of radioactive materials, exposure to external penetrating radiation, and the environmental contamination of air or water by radioactive materials. The Union Carbide plants have played a significant part in the determination of these permissible values, both by direct experimental and theoretical work and by participation of their employees in the activities of the various committees. In addition, experimental and theoretical work at these plants has permitted the determination and use of correspondingly safe limits for uranium dust contamination of hands, clothing, and work surfaces as well as providing very conservative values for relating urinary uranium excretion rates to possible body deposition. The Union Carbide plants have also been active in the design of radiation detection instrumentation to provide as accurate information as possible concerning both environmental conditions and possible personnel exposures.

Although the radiation exposure monitoring techniques used by the various plants are basically similar, and their criteria for specifying actual exposures are based on applicable standards, their administrative methods for seeing that employee exposures do not exceed the maximum permissible limits are designed to best fit the particular administrative and technical activities of the individual plant. In some cases, these may involve action points at control levels below the permissible limits, and such controls as limitation of employees' work activities may be involved. The selection of such control values and the actions specified are based upon considerations of convenience, economy, operational efficiency, or other factors. In many cases, it has been found entirely feasible to control exposures or environmental levels to values much below the nationally recognized permissible levels; however, meeting these permissible levels continues to form the basis of the radiation control program.

ADMINISTRATIVE AND ORGANIZATIONAL ACTIVITIES

Safety has always been recognized as an integral and important part of the efficient operation which has characterized Union Carbide operations. Hence, all of the plants have the basic philosophy that each member of the line organization, which includes all employees, has the prime responsibility for the prevention of injury or radiation exposure commensurate with his responsibility for production or other operational activities. Adequate supplies of radiation detection instruments are maintained, and, in general, each employee who can come in contact with penetrating radiation or radioactive materials may be expected to use these instruments for his own protection and that of the employees he supervises. Training in such use is, of course, provided. Appropriate radiation and contamination markers are made available for the purpose of identifying radiation field boundaries or to provide other precautionary information.

In addition to line organizational activities, staff groups have been established at each of the plants to provide technical information and assistance; to make periodic reviews, including inspections and audit checks of plant and organizational activities for management; and to provide certain appropriate services, such as film meter processing and consequent evaluation of possible personnel exposures to radiation. Also included in the activities of these groups are thorough design and pre-operational analyses and evaluations of the radiation protection aspects of proposed facilities and operations, periodic environmental checks of plant activities and equipment, and the evaluation of the data thus provided for the use of the line organization, including management. In addition, various service groups, such as those of engineering, laboratory, and maintenance, provide specialized services peculiar to their own type of operations. As a part of their over-all health and safety programs, each plant also maintains adequate medical facilities and staff, with periodic and special health examinations forming a part of the medical attention provided employees. As with conventional medical practices, the health aspects of radiation, including evaluations of clinical findings, are discussed with employees, and any results of the personnel radiation monitoring programs, as they may involve an employee, are made available to him.

PERSONNEL MONITORING

All employees whose work may be expected to bring them into contact with external penetrating radiation are issued film badges which are read and evaluated on an appropriate schedule. In addition, "visitor" badges are available for other personnel who may enter these locations, and their use required.

Employees working in locations where exposure to air-borne radioactive materials is possible are given periodic urinalyses both to check the adequacy of control activities and to evaluate the possibility that internal exposures are occurring; similar checks are made after any indicated exposure resulting from material releases or other sources. An in-vivo body counter for the evaluation of internal material deposits of U-235-enriched uranium has also been established.

In all usage of personnel exposure data, the resulting actions are based upon comparisons to recognized permissible limits or plant control limits, with major attention given to seeing that exposures or environmental conditions do not exceed nationally recognized limits.

ENVIRONMENTAL MONITORING

The air in locations subject to significant contamination by uranium or other radioactive materials is routinely and continuously monitored on a shift-length basis. In addition, short-term samples are taken for specific jobs as a part of routine audit and inspection activities in various plant locations.

Measurements of alpha activity upon floors and various work surfaces are made to evaluate any changes in radiation problems in various locations concerned and to determine the effectiveness of control measures. Similarly, audit inspections may include checks not only of conditions and locations where penetrating radiation and radioactive contamination can be expected, but also of employees' hands, clothing, tools, etc., as well as office facilities and similar locations where radiation or contamination by radioactive materials is normally not anticipated.

A continuing check is also maintained by the production plants upon the small quantities of uranium or other radioactive materials released to the environs. At ORNL as at other reactor locations, disposal of the high-radiation-level wastes at levels not exceeding the permissible values requires major control activities. This includes routine control of both liquid and gaseous wastes, adequate measurements thereof, and due considerations for possible emergency control.

EDUCATION

The training programs at all of the plants have been designed to acquaint employees, as necessary and appropriate, with the facts concerning radiation hazards, applicable limits, and proper protective methods, especially as their own jobs are concerned. In addition, the various plant organizations have prepared both technical and administrative information concerned with radiation protection for the information and use of plant personnel.

EXPERIENCE - 1959

1. There were no indicated exposures above 12 rem for the year and no additional exposure was received by any of the six employees whose exposures above permissible limits as a result of incidents during preceding years has necessitated annual "averaging" to meet the 5 rad/year average lifetime (since age 18) exposure.
2. The best available monitoring techniques indicated that no employees had the possibility of internal body deposits of the order of the respective maximum permissible limits for the radionuclides of concern.
3. Only ORNL had considerations of radioactive materials release to the environment at levels which were significantly above background; this resulted in a maximum average activity in local streams of only some 25% of the applicable maximum permissible limits for drinking water. In addition, the highest average air activity measured in the neighborhood of the plant was only some 2% of the permissible levels. Corresponding releases by the other Union Carbide plants had negligible effects upon the environment.

COSTS OF RADIATION PROTECTION

1. Routine Operations

   Annual routine operating costs of radiation protection at the four Union Carbide plants amount to some $1,610,000, which is about $106 per plant employee and some 0.5% of the total operating costs of these facilities. Such cost figures include only the labor and support expenses of those personnel whose principal responsibility is specifically connected with the radiation protection programs of the various plants. Various items of capital costs, research expenditures, and incidental or "fringe benefit" types of costs are excluded from these figures although it is recognized that these latter items alone may very easily result in total expenses above the figures quoted.

2. Estimates of Additional Costs Resulting From Changes in the Maximum Permissible Limits.

An ability to maintain exposures at the current maximum permissible limits, which are essentially those which have been in effect for some 10-15 years although there have been minor changes, has been built into plant equipment and operations. The success of these efforts in limiting exposures to these permissible values is indicated by the small number of exposures and potential exposures above the respective permissible limits which have been determined.

In many instances, this built-in protection has resulted in significant capital expenses which would not have been necessary had the permissible limits not been as low as was the case at the time of construction. Hence, were it established that the limits could be safely raised by a significant factor, the principal resultant saving would be that of routine operating expense, and this would be comparatively small. However, significant savings could be realized in the design and operation of a new facility where these hypothetical higher limits were in effect. These savings would appear both in smaller direct capital costs of construction and in the lower costs associated with the design, development, and installation of the highly specialized devices which have been found necessary to limit personnel exposure to penetrating radiation or to control the release of radioactive materials in the plant environment. In many cases, these requirements have resulted in specially-constructed and correspondingly expensive items of equipment to perform routine operations, such as valving. No attempt has been made to evaluate these potential savings.

On the other hand, a reduction in the permissible limits by a factor of 10 would result in significant expenses and almost prohibitive difficulties in operation. In many cases, attempts to meet such limits would probably necessitate rather complete redesign of equipment. For example, there are some operations wherein measurements show that the release of uranium materials to the air can be adequately controlled at current maximum permissible limits during maintenance operations involving opening the system to the general building environment. However, were the air contamination limits to be reduced by a factor of 10, such maintenance would probably require dry-box-type controls. Similarly, there are maintenance-type operations in the laboratory wherein it has been found feasible to use time-of-work limitations of personnel exposure; a reduction of permissible limits would probably mean that an expensive remote-control type of maintenance would be necessary. In some instances, operating changes of the types mentioned would be impossible in present equipment locations so that entirely new facilities may be required.

The effect of such a change in permissible limits upon personnel activites is obviously difficult to evaluate. It could, for example, mean the regular use of protective devices, such as respiratory protection units during essentially all of a work period; it could also result in the need for special decontamination techniques. In fact, the high additional capital costs associated with such changes in the limits, as well as the operational difficulties envisaged, may make plans for more extensive automation of operations an attractive alternative to present methods; this could result in a decrease in manpower requirements and a consequent reduction in certain types of operating expense.

Due to the fact that many of these limits would be near background or the limit of current instrument sensitivity, considerably greater care in monitoring techniques, instrument maintenance, and analytical methods could result if obtaining the necessary data proves feasible. Certainly, the precision of determination of the factors concerned would be considerably lessened.

An order-of-magnitude estimate of some of the costs which might be involved in a reduction of permissible limits by a factor of 10 is indicated below for the capital expense of certain limited operations in the various Union Carbide facilities; it should be emphasized that these figures do not refer to the total costs to the plants of such a change but only to capital costs of a few operations which are relatively isolated and which use standardized techniques so that an evaluation of this type is relatively feasible.

UF_6 Manufacture	-	\$2,000,000
Liquid Waste Disposal	-	\$1,500,000
Enriched Uranium Recovery	-	\$3,000,000

CONCLUSIONS

Based upon experience in the plants operated by Union Carbide Corporation, including the results of monitoring and clinical data, it may be concluded that:

1. The maximum permissible limits of the National Committee on Radiation Protection as stated in NBS Handbooks 59, 63, and 69 have proven effective guide lines in maintaining personnel exposures during routine operations below levels at which any indications of injury or potential injury have been observed. The only indications of potential injury have been the results of accidents when such limits have been grossly exceeded.

2. Plant equipment and facilities as currently designed and operated provide adequate means for meeting the permissible limits as noted.

3. A reduction in the current permissible limit values would result, in many cases, in both high capital costs, high routine operating expense, and comparatively inefficient operating procedures.

4. A significant increase in the current values of the permissible limits could result in much of the production plant areas, particularly those where normal uranium is handled, operating as any facility where radiation is not a problem; health controls would be based upon the chemical toxicity of the uranium even more strongly than is now the case. However, although some savings in operating expense could accrue from an increase in these limits, major savings would result only with new

installations since the capital expenditure which was necessary for meeting the current limits has already been made.

5. All of the plants have been peculiarly successful in evaluating and establishing adequate control methods for these special hazards, especially for those presenting the greatest potential hazard to personnel.

6. Where technical data concerning problems peculiar to the operating plants were lacking to the extent that conservative and restrictive control measures were considered necessary in the absence of such information, the plants themselves have obtained the necessary experimental or theoretical data and have established adequate control levels for these considerations.

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J. Lamb / 1034A (Item 7)

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Date of request 6/14/96 ~~[illegible]~~ ~~[illegible]~~ Expected receipt of document 7/14/96 ~~[illegible]~~ ~~[illegible]~~

Document number Unnumbered / DFI / Date of document 1960

Title and author (if document is unnumbered) (7 items)

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Date received from CICO 7/16/96

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Signature ______

CC: Jennifer Lamb

CC: (enc) Steve Wiley
Linda Hill
See release 7/11/96

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Item 6 -	K-25 Document
Item 7 -	K-25 Document

SG Thornton
7/11/96

Rough Draft #1 Unnumbered IDF I

RADIATION PROTECTION CRITERIA AND STANDARDS, THEIR BASIS AND USES AT ATOMIC ENERGY FACILITIES OPERATED BY UNION CARBIDE CORPORATION

PART II. OAK RIDGE GASEOUS DIFFUSION PLANT

GENERAL INFORMATION

The principal production activity of the Oak Ridge Gaseous Diffusion Plant is the separation of uranium-235 from normal uranium, although operations also include other adjunct activities, such as barrier production and recovery of material.

The over-all plant operations currently include five major (1) separation units, a feed production facility, barrier manufacturing facilities, a steam-powered electrical generating station, and a host of service and auxiliary functions. The plant area comprises 616 acres and includes 253 buildings. Of this latter number, approximately 90% are principally of steel and fire-resistant construction while the remainder are frame buildings of war-time construction; sprinkler protection is provided for most of these facilities. Current plant employment is about 4000.

The uranium enters plant operations as a purified oxide (UO_3) which is processed through several steps culminating in its fluorination to uranium hexafluoride (UF_6). The material is then passed through the gaseous diffusion cascade wherein it is highly enriched 2 in the U-235 isotope and sent from the plant for further appropriate finishing or usage. Materials at intermediate enrichments are also withdrawn for special projects as requested.

Prepared by Union Carbide Corporation-Nuclear Division, operating contractor for the U.S. Department of Energy under U.S. Government Contract No. W-7405-eng-26.

The major possibility of dangerously high levels of penetrating radiation at the ORGDP, and the only possibility of neutron radiation, would result from an accidental critical mass excursion, although there have been no such incidents in plant history. On a routine basis, the principal radiation protection consideration is that concerned with the possibility of internal exposure from the alpha-emitting uranium. In addition, there are also comparatively minor considerations of routine exposure to beta-gamma penetrating radiation from uranium daughters and from trace quantities of other radioactive isotopes encountered in the reprocessing of uranium from the spent fuel of various power, production, and research reactors. Small quantities of other radioactive materials are, on occasion, used in the laboratories for research and development purposes or as radiation sources.

3.

4.

STANDARDS USED

1. The permissible limits of NBS Handbook 59, including amendments through April 15, 1958, and NBS Handbook 69 form the basis for standards in use at the Oak Ridge Gaseous Diffusion Plant; personnel are considered over-exposed if the appropriate limits are exceeded. In general, these provide criteria for exposure to penetrating radiation (Handbook 59) and the possibility of internal exposure (Handbook 69) as expressed in terms of concentrations of the respective radionuclides in air and water and permissible "body burdens" or body deposits.

Since there is no direct method for determining body deposits of material, the indirect method of urinalysis is used for this purpose. For determining air contamination, both direct measurements of uranium concentrations in the air and indirect determinations through evaluations of surface levels are used to evaluate the possibility of employees being exposed through inhalation.

Plant wastes released into streams are monitored to insure
that the concentration of these materials in the streams leaving
the plant boundaries do not exceed the permissible limits for 5
drinking water of the general population. Although there is no
possibility that these wastes can contaminate the plant potable 6
water supply, the intake water is monitored for beta-gamma 7
emitting radionuclides to insure that the levels of these
materials in plant drinking water do not exceed the respective
permissible limits of Handbook 69.

In addition to the use of permissible limits to evaluate personnel exposure or the possibility thereof, control points at values below these permissible levels are also used to maintain environmental conditions at low levels for reasons other than direct health protection or to insure that permissible limits will not be exceeded. Uranium, both normal and that enriched in the U-235 isotope, is the principal radionuclide of concern and the limits and control points as listed below are primarily associated with this material. However, similar limits are used for other radionuclides which, as noted above, may appear as trace quantities in certain operating locations of the Gaseous Diffusion Plant. From analytical or engineering considerations, the practical units used in the plant for environmental control and evaluation are not always the same as those given in NBS handbooks but are related closely thereto. In some instances, the practical units are given in the following tabulations.

2. External Radiation

   a. Maximum permissible limits (Handbook 59)

      1) Gamma

         3 rad/quarter, 12 rad/year, and 5 rad/year average since age 18.

      2) Beta

         6 rad/quarter, 24 rad/year, and 10 rad/year average since age 18.

      3) Mixed beta and gamma

         In a practical extension of the above values, the total rad dose for mixed beta and gamma exposure is considered as being the sum of the gamma dose and half of the total beta dose, and the gamma limits given above are used for this dose-equivalent. It is recognized that beta and gamma exposures are not necessarily directly additive, but use of this practical unit not only reduces bookkeeping expense but also results in somewhat conservative values as compared with individual gamma or beta measurements; for example, it will indicate both over-exposures due to beta or gamma alone and also those due to a combined exposure in which neither the beta nor the gamma exposure is above the maximum permissible limit.

b. <u>Additional Control Values</u>

Exposures of 1 rad dose-equivalent as described above.

c. <u>Actions Taken at Permissible Limits and Control Levels</u>

1) 1 rad in a month - Employee activities and work environment reviewed by staff and supervisory groups and appropriate action taken.

2) 3 rads in a quarter - In addition to action described in 2.c.1), the employee's past radiation history is also reviewed and appropriate action taken. This may include rotating an employee into other equivalent work.

3) 12 rads in a year - In addition to action described in 2.c.2), the employee will be rotated to other work to see that he does not have an average exposure greater than 5 rad/year since age 18.

3. <u>Internal Exposure</u>

a. <u>Air Contamination</u>

Maximum permissible concentrations as specified by the NCRP for 40-hour/week exposures to the materials of concern. For uranium, a convenient value of 1 c./min./ft.^{3} which is equivalent to about 5×10^{-11} μc./ml. or 100 dis./min./m.^{3} is used.

b. <u>Water Contamination</u>

10% of the maximum permissible concentration for the materials involved as specified by the NCRP in NBS Handbook 69 for 40 hour/week exposure.

c. <u>Internal Body Deposits</u>

The maximum permissible concentrations as specified by the NCRP in NBS Handbook 69. Indirect methods of indicating such deposits are necessary and these are expressed as control or action points.

d. <u>Additional Control Values</u>

1) <u>Internal Deposits</u>

Urinary excretion levels as given below are considered as indicating the possibility of significant internal body deposition of uranium, but not necessarily near the maximum permissible levels of the NCRP on a long-term basis.

a) 70 dis./min./24-hour sample. Measurement made at least 1 week after any possibility of potential exposure of the employee is eliminated. (Average over 6-month period.)

b) 350 dis./min./24-hour sample. Measurement made at least 24 hours after potential exposure of the employee is eliminated. (Average over 6-month period.)

c) Three consecutive weekly readings of at least 0.01 mg. uranium/liter or 2.6 dis./min./100 ml. plus an additional similar reading for a sample taken after an employee has had no potential exposure to uranium for at least 48 hours.

2) Surface Contamination by Uranium

Average transferable levels of 0.3 dis./min./cm.^{2}, 3 dis./min./cm.^{2}, or 30 dis./min./cm.^{2}.

3) Clothing Contamination

40 c./min./cm.^{2} or 650 dis./min./cm.^{2}.

e. Actions Taken at Permissible Limits and Control Levels

1) Air (See Part 3.a.) - Engineering and personnel protection actions taken as necessary if the value given is exceeded as averaged over periods of at least 8 hours. (Note: The value stated for uranium is actually based upon chemical toxicity of normal uranium with permissible limits for uranium enriched in the U-235 isotope being much higher. This single value is used for convenience, however, as a control point.)

2) Water (See Part 3.b.) - Although the activity of the intake potable water is not directly under the control of the ORGDP and there is little possibility, if any,

of plant releases contaminating this water, plans which may include a temporary shutoff of the water input have been made to cope with emergencies; to date, water levels have been well below permissible limits.

3) Urinalyses

a) See Part 3.d.1)a) and b) - Employees are rotated to other work until urinalyses show no possibility of long-term average exposures above the NCRP levels.

b) See Part 3.d.1)c) - Employees are removed from potential exposures to uranium until urinalyses show no activity.

4) Surface Contamination

Appropriate action which may include removal, shielding, or other controls is taken. Employees may be required to use respiratory protection on a short-term basis.

5) Clothing Contamination

Clothing is changed and cleaned below the action point before reuse.

4. Waste Disposal

For release to waterways, the uranium concentration or activity will be no greater than the MPC given in NBS Handbook 69 for continuous exposure to the general population at the point the stream leaves plant boundaries. Similarly, the air contamination at the plant boundary will be no greater than that permissible for the general population as given in Handbook 69.

OPERATING METHODS

1. <u>Personnel Responsibility</u>

   a. <u>General</u>

   At the ORGDP, radiation protection is appropriately treated as only one phase of the over-all plant accident prevention program which includes due precautions for safety in operations involving processes and materials which can present significant hazards on a routine basis, many of these probably being greater than those of radiation. (8)

   b. <u>Line Organization</u>

   Responsibility for the protection of employees against radiation health hazards rests with members of the line (9) organization to the same extent that they are responsible for operation and production. As a part of their responsibilities, they may monitor their areas, provide employees with necessary protective equipment and enforce its use, assist in evaluating and handling the personnel aspects of any cases of exposure, and maintain a high standard of housekeeping, this including such cleaning as necessary to remove radioactive materials. Each employee is expected to follow rules and regulations pertaining to health hazards established for his location and job assignment, monitor his person and work area as required, and notify his immediate supervisor of any known exposure to radioactive materials or of conditions exceeding the maximum allowable radiation or contamination values which have not been properly controlled.

c. Staff Groups

In addition to the line organization, staff groups have been organized with the prime responsibilities of providing information as necessary, auditing line organizational activities, determining the effectiveness of control measures employed, and providing such necessary routine services as film badge monitoring in the radiation control and reporting programs. Since radiation protection at the Oak Ridge Gaseous Diffusion Plant is appropriately considered as only one phase of the overall radiation protection program, it has been both efficient and practicable to include the basic staff radiation protection responsibility in a group which also has similar responsibilities for other parts of the plant safety program. In addition, certain activities closely related to radiation protection are provided by such service groups as those in the analytical laboratory, engineering, and maintenance organizations. The section of this review headed ESTIMATED COSTS OF RADIATION

PROTECTION lists the numbers of plant personnel involved in these major radiation protection activities. This listing actually reflects in each case an equivalent categorization of the personnel in a larger group, the members of which also have additional responsibilities.

2. Determinations of Exposures and Potential Exposures

a. External Radiation

All employees whose work may be expected to bring them into contact with external penetrating radiation are issued film badges which are read and evaluated on an appropriate schedule, currently monthly. In addition, "visitor" badges are available for other personnel who may enter these locations, and their use required; these are read at the termination of the visit. In general, regular badges are issued where any potential exposure for a period of as long as a month is anticipated.

b. Internal Exposures

Employees working in locations where exposure to air-borne radioactive materials is possible are given periodic urinalyses both to check the adequacy of control activities and to evaluate the possibility that internal exposures are occurring; similar checks are made after any indicated exposure resulting from material releases or other sources.

c. <u>Environmental Checks</u>

The air in locations subject to significant contamination by uranium or other radioactive materials is routinely and continuously monitored on a shift-length basis. In addition, short-term samples are made for specific jobs and as a part of routine audit and inspection activities in various plant locations. Measurements of alpha-activity upon floors and various work surfaces are made to evaluate any changes in radiation problems in the various locations concerned and to determine the effectiveness of control measures. Similarly, audit inspections may include checks of employee hands, clothing, tools, etc., as well as office facilities and similar locations. A continuing check is also maintained by the production plants upon the small quantities of uranium or other radioactive materials released to the plant streams and atmosphere.

3. <u>Radiation Protection Activities</u>

a. Since significant radiation protection characteristics are frequently a function of the design and manufacture of equipment and facilities, the ORGDP incorporates necessary shielding and other controls during design activities. It is recognized that a clean working environment and confinement of material are prime requisites for preventing possible exposure to such alpha-emitting materials as uranium, the primary radionuclide of concern at the ORGDP. Adequate confinement of material requires specific design considerations, efficient operating methods, and effective administrative and supervisory procedures. Of prime importance in design and operation is the requirement that there be no part of the operation or location where material continuously escapes into an unconfined region. Thus, it is plant policy to so design equipment and specify its operation that contaminating materials will be as well confined as practicable, and any routine material release will not cause the maximum permissible concentrations in the environment to be exceeded.

b. <u>Personnel Protection</u>

Where it is not practicable to maintain air-borne or surface contamination below the points at which they may represent appreciable sources of exposure, protective equipment, possibly including certain items of clothing, are furnished the employee as needed and he is required to use them. The most important of these personnel protection items are gas masks and respirators which are made available where contamination of the air is considered to present a problem; the use of these items is required as conditions warrant. In some cases where respiratory protection is necessary, the use of some items of company clothing may also be required.

c. Personal Hygiene

Adequate facilities for good personal hygiene are furnished, and instruments are provided to enable the employee to determine if his hands and clothing are above the permissible limits. Personnel hand checks may be made mandatory before eating, smoking, or shift change. Where contamination is below a point considered to represent an appreciable hazard, the devices and items noted above may also be provided on optional bases to those employees who desire them. (11)

d. Use of Radiation Detection Instruments

It is plant policy to identify contaminated articles or areas and to separate such articles and areas as well as practicable. Adequate radiation detection instruments are made available to the l[illegible] organization to aid them in identifying contami[illegible]ticles and areas and to provide them with [illegible]or measuring the extent of the environmental c[illegible]ation.

e. Audit Program

Members of the staff groups periodically review actual plant practices and activities, evaluate them from the viewpoint of radiation protection, and provide reports for appropriate levels of management concerning their findings and the meaning thereof.

f. Education

Technical and administrative information concerning the radiation protection aspects of specific plant activities has been prepared and made available to plant personnel in accord with their requirements as necessary and appropriate. This has been supplemented by periodic training programs designed to insure that employees were aware of the radiation protection requirements of their specific jobs, including such items as protective equipment, applicable limits, and detection methods.

EXPERIENCE - 1959

1. External Exposure

   a. Greater than 3 rem/quarter, 12 rem/year, or 5 rem/year - None.

   b. Greater than 1 rem/month - 5. Action taken - As described.

2. Internal Deposits

   a. Air Contamination

      1) Average air activity greater than the maximum permissible limit for 8 hours - 1471 (These comprise 12% of

the total shift length samples taken.)

2) Action Taken - Engineering design to confine material; short-term usage of respiratory protection by personnel as necessary. (Practically all of these samples resulted from averaging, over the entire shift, short periods of comparatively high level activity originating from systems opened for maintenance; respiratory protection is used during these short periods.)

b. Water Activity

1) At no time did the peak activity in the potable water supply exceed the long-term maximum permissible concentrations specified for the radionuclides of interest for as short a time as the one-week sampling period. The intake water averaged some 0.99% of the occupational MPC for the year for these radionuclides.

c. Urinalysis and Clinical Data

1) At no time has there been any clinical evidence of personnel injury as a result of exposure to uranium materials.

2) Urinalysis results greater than those given in STANDARDS USED, Parts 3.d.1)-a) and -b) - None.

3) Urinalysis results greater than that given in STANDARDS USED, Part 3.d.1)-c) - 73.

4) Action Taken - Employees were removed from exposure or potential exposure to uranium materials for an average period of 20 days.

d. Surface Contamination

1) Only 1.2% of the total surface area had average contamination as high as 0.3 dis./min./cm.^{2}.

2) Only 5 locations involving some 46,910 ft.^{2} of area had average surface activities of as much as 30 dis./min./cm.^{2} for periods of as short as 3 months.

3) Action Taken - As described, this including cleanup, engineering design, and personnel protection.

e. Clothing Contamination

1) Surface activities above control point - None.

3. Waste Disposal

a. Water release at the plant boundaries above the long-term maximum permissible concentrations for as short times as the weekly sampling period - None. Average release level for the year was some 0.01% of the maximum permissible concentration for discharge of natural uranium.

b. Mud in stream bottoms - Showed no significant difference from that of the background mud in one of the TVA basins.

ESTIMATED COSTS OF RADIATION PROTECTION

1. Basic Costs (12)

Staff Groups	- 11 Personnel	- $110,000
Laboratory Analysis	- 4 Personnel	- 40,000
Instrument Engineering and Maintenance	- 5 Personnel	- 50,000
Instruments		- 20,000
	Total:	$220,000

2. The $220,000 basic operating cost of the ORGDP radiation protection program represents an expenditure of approximately $5 per plant employee or 0.2% of the plant operating expense. The figures given in Part 1 include support costs of the respective staff and service functions noted, the limited experimental and development work carried on at the ORGDP, and the operating costs of the plant film badge program. (12)

3. The figures of Part 1 do not include the increased capital costs of equipment and facilities resulting from radiation protection considerations. They also do not include costs such as those involved in the provision and use of protective equipment, emergency preparations, engineering design, the removal of radioactive contamination from various surfaces, or the radiation monitoring done by operations employees as a relatively small part of their normal jobs. The costs of various "fringe benefit" items, such as employee wash-up time (13) or clothing change time, which are ostensibly based on radiation protection but in reality have only minimal effects upon such protection are also omitted; these costs alone may easily be greater than those noted in Part 1 as the general direct program expense.

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J. Lamb / 1034A Item 6

Requestor / Document Center (is requested to provide the following document)

Date of request 6/14/96 ~~2/26/96~~ ~~3/25/96~~ Expected receipt of document 7/14/96 ~~3/26/96~~ ~~4/30~~

Document number Unnumbered/IDF2 Date of document 1960

Title and author (if document is unnumbered) (7 Items)

Radiation Protection Criteria and Standards: Use at UCC Facilities.

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Date request received 6/19/96

Date submitted to ADC 7/11/96

Date submitted to HSA Coordinator 6/19/96

(This section to be completed by HSA Coordinator)

Date submitted to CICO 7/11/96

Date received from CICO 7/16/96

Date submitted to ChemRisk/Shonka and DOE 7/16/96

(This section to be completed by ChemRisk/Shonka Research Associates, Inc.)

Date document received

Signature

CC: Jennifer Lamb

CC: Steve Wiley
Linda Hill
See release 7/11/96

cc w/enc: Linda Hill - Item 1
Steve Wiley - Item 5; Item 2 which contains multisite information must be reviewed for classification by K-25 and ORNL, PGDP, and Y-12--Y-12 will be responsible for release of document after all classification reviews are completed
Sheila Thornton - Items 4, 6, and 7
Sheila Thornton - Item 3 (PGDP document to be sent to PGDP for release)

cc: Jennifer Lamb - For your information

Item 1 - ORNL Document
Item 2 - Y-12 Document which contains multisite information requiring classification review by K-25, ORNL, PGDP, and Y-12
Item 3 - PGDP Document
Item 4 - K-25 Document
Item 5 - Y-12 Document
Item 6 - K-25 Document
Item 7 - K-25 Document

SG Thornton
7/11/96

Rough Draft #2
Unnumbered 1 OF 2

RADIATION PROTECTION CRITERIA AND STANDARDS, THEIR BASIS AND USES AT ATOMIC ENERGY FACILITIES OPERATED BY UNION CARBIDE CORPORATION

PART II. OAK RIDGE GASEOUS DIFFUSION PLANT

GENERAL INFORMATION

The principal production activity of the Oak Ridge Gaseous Diffusion Plant is the separation of uranium-235 from normal uranium, although operations also include other adjunct activities, such as barrier production and recovery of material.

The over-all plant operations currently include five major separation units, a feed production facility, barrier manufacturing facilities, a steam-powered electrical generating station, and a host of service and auxiliary functions. The plant area comprises 616 acres and includes 253 buildings. Of this latter number, approximately 90% are principally of steel and fire-resistant construction while the remainder are frame buildings of war-time construction; sprinkler protection is provided for most of these facilities. Current plant employment is about 4000.

The uranium enters plant operations as a purified oxide (UO_3) which is processed through several steps culminating in its fluorination to uranium hexafluoride (UF_6). The material is then passed through the gaseous diffusion cascade wherein it is highly enriched in the U-235 isotope and sent from the plant for further appropriate finishing or usage. Materials at intermediate enrichments are also withdrawn for special projects as requested.

The major possibility of dangerously high levels of penetrating radiation at the ORGDP, and the only possibility of neutron radiation, would result from an accidental critical mass excursion, although there have been no such incidents in plant history. On a routine basis, the principal radiation protection consideration is that concerned with the possibility of internal exposure from the alpha-emitting uranium. In addition, there are also comparatively minor considerations of routine exposure to beta-gamma penetrating radiation from uranium daughters and from trace quantities of other radioactive isotopes encountered in the reprocessing of uranium from the spent fuel of various power, production, and research reactors. Small quantities of other radioactive materials are, on occasion, used in the laboratories for research and development purposes or as radiation sources.

STANDARDS USED

1. General Review

   The permissible limits of NBS Handbook 59, including amendments through April 15, 1958, and NBS Handbook 69 form the basis for standards in use at the Oak Ridge Gaseous Diffusion Plant; personnel are considered over-exposed if the appropriate limits are exceeded. In general, these provide criteria for exposure to penetrating radiation (Handbook 59) and the possibility of internal exposure (Handbook 69) as expressed in terms of concentrations of the respective radionuclides in air and water and permissible "body burdens" or body deposits.

Since there is no direct method for determining body deposits of material, the indirect method of urinalysis is used for this purpose. For determining air contamination, both direct measurements of uranium concentrations in the air and indirect determinations through evaluations of surface levels are used to evaluate the possibility of employees being exposed through inhalation.

Plant wastes released into streams are monitored to insure that the concentration of these materials in the streams leaving the plant boundaries do not exceed the permissible limits for drinking water of the general population. Although there is no possibility that these wastes can contaminate the plant potable water supply, the intake water is monitored for beta-gamma emitting radionuclides to insure that the levels of these materials in plant drinking water do not exceed the respective permissible limits of Handbook 69.

In addition to the use of permissible limits to evaluate personnel exposure or the possibility thereof, control points at values below these permissible levels are also used to maintain environmental conditions at low levels for reasons other than direct health protection or to insure that permissible limits will not be exceeded. Uranium, both normal and that enriched in the U-235 isotope, is the principal radionuclide of concern and the limits and control points as listed below are primarily associated with this material. However, similar limits are used for other radionuclides which, as noted above, may appear as trace quantities in certain operating locations of the Gaseous Diffusion Plant. From analytical or engineering considerations, the practical units used in the plant for environmental control and evaluation are not always the same as those given in NBS handbooks but are related closely thereto. In some instances, the practical units are given in the following tabulations.

2. External Radiation

a. Maximum permissible limits

1) Gamma

3 rad/quarter, 12 rad/year, and 5 rad/year average since age 18.

2) Beta

6 rad/quarter, 24 rad/year, and 10 rad/year average since age 18.

3) Mixed beta and gamma

In a practical extension of the above values, the total rad dose for mixed beta and gamma exposure is considered as being the sum of the gamma dose and half of the total beta dose, and the gamma limits given above are used for this dose-equivalent. It is recognized that beta and gamma exposures are not necessarily directly additive, but use of this practical unit not only reduces bookkeeping expense but also results in somewhat conservative values as compared with individual gamma or beta measurements; for example, it will indicate both over-exposures due to beta or gamma alone and also those due to a combined exposure in which neither the beta nor the gamma exposure is above the maximum permissible limit.

b. Additional Control Values

Exposures of 1 rad dose-equivalent as described above.

c. Actions Taken at Permissible Limits and Control Levels

1) 1 rad in a month - Employee activities and work environment reviewed by staff and supervisory groups and appropriate action taken.

2) 3 rads in a quarter - In addition to action described in 2.c.1), the employee's past radiation history is also reviewed and appropriate action taken. This may include rotating an employee into other equivalent work.

3) 12 rads in a year - In addition to action described in 2.c.2), the employee will be rotated to other work to see that he does not have an average exposure greater than 5 rad/year since age 18.

3. Internal Exposure

a. Air Contamination

Maximum permissible concentrations as specified by the NCRP for 40-hour/week exposures to the materials of concern. For uranium, a convenient value of 1 c./min./ft.^{3} which is equivalent to about 5×10^{-11} μc./ml. or 100 dis./min./m.^{3} is used. (Note: This value is actually based upon chemical toxicity of normal uranium with permissible limits for uranium enriched in the U-235 isotope being much higher. This single value is used for convenience, however, as a control point.)

b. Water Contamination

10% of the maximum permissible concentration for the materials involved as specified by the NCRP in NBS Handbook 69 for 40 hour/week exposure. Where water contamination is maintained at this level, the resulting exposure is considered as having essentially no effect upon the permissible level of other, and major, sources of exposure.

c. Internal Body Deposits

The maximum permissible concentrations as specified by the NCRP in NBS Handbook 69. Indirect methods of indicating such deposits are necessary and these are expressed as control or action points.

d. Additional Control Values

1) Internal Deposits

Urinary excretion levels as given below are considered as indicating the possibility of significant internal body deposition of uranium, but not necessarily near the maximum permissible levels of the NCRP on a long-term basis.

a) 70 dis./min./24-hour sample. Measurement made at least 1 week after any possibility of potential exposure of the employee is eliminated. (Average over 6-month period.)

b) 350 dis./min./24-hour sample. Measurement made at least 24 hours after potential exposure of the employee is eliminated. (Average over 6-month period.)

c) Three consecutive weekly readings of at least 0.01 mg. uranium/liter or 2.6 dis./min./100 ml. plus an additional similar reading for a sample taken after an employee has had no potential exposure to uranium for at least 48 hours. It is recognized that an employee meeting this criterion can have essentially no body deposition, certainly over the long term, and this conclusion is borne out by experience. This practice results in substantial economies in analytical and bookkeeping expenses which would otherwise be necessary to maintain average exposures near a permissible limit.

2) Surface Contamination by Uranium

Average transferable levels of 0.3 dis./min./cm.^{2}, 3 dis./min./cm.^{2}, or 30 dis./min./cm.^{2}. Experiments have shown that at the last-listed level, the maximum air contamination considered possible is of the order of 10% of the maximum permissible level for air contamination.

3) Clothing Contamination

40 c./min./cm.^{2} or 650 dis./min./cm.^{2}. Clothing contaminated to this level by uranium dusts as found at the ORGDP can result in possible contamination of the air breathed by an individual at some 10% of the permissible level for air activity.

e. Actions Taken at Permissible Limits and Control Levels

1) Air (See Part 3.a.) - Engineering and personnel protection actions taken as necessary if the value given is exceeded as averaged over periods of at least 8 hours.

2) Water (See Part 3.b.) - Although the activity of the intake potable water is not directly under the control of the ORGDP and there is little possibility, if any, of plant releases contaminating this water, plans which may include a temporary shutoff of the water input have been made to cope with emergencies; to date, water levels have been well below permissible limits on the control values of the ORGDP.

3) Urinalyses

a) See Part 3.d.1)a) and b) - Employees are rotated to other work until urinalyses show no possibility of long-term average exposures above the NCRP levels.

b) See Part 3.d.1)c) - Employees are removed from potential exposures to uranium until urinalyses show no activity.

4) Surface Contamination

Appropriate action which may include removal, shielding, or other controls is taken. Employees may be required to use respiratory protection on a short-term basis.

5) Clothing Contamination

Clothing is changed and cleaned below the action point before reuse.

4. Waste Disposal

For release to waterways, the uranium concentration or activity will be no greater than the MPC given in NBS Handbook 69 for continuous exposure to the general population at the point the stream leaves plant boundaries. Similarly, the air contamination at the plant boundary will be no greater than that permissible for the general population as given in Handbook 69.

OPERATING METHODS

1. Personnel Responsibility

   a. General

   At the ORGDP, radiation protection is appropriately treated as only one phase of the over-all plant accident prevention program which includes due precautions for safety in operations involving processes and materials which can present significant hazards on a routine basis, many of these probably being greater than those of radiation.

   b. Line Organization

   Responsibility for the protection of employees against radiation health hazards rests with members of the line organization to the same extent that they are responsible for operation and production. As a part of their responsibilities, they may monitor their areas, provide employees with necessary protective equipment and enforce its use, assist in evaluating and handling the personnel aspects of any cases of exposure, and maintain a high standard of housekeeping, this including such cleaning as necessary to remove radioactive materials. Each employee is expected to follow rules and regulations pertaining to health hazards established for his location and job assignment, monitor his person and work area as required, and notify his immediate supervisor of any known exposure to radioactive materials or of conditions exceeding the maximum allowable radiation or contamination values which have not been properly controlled.

c. Staff Groups

In addition to the line organization, staff groups have been organized with the prime responsibilities of providing information as necessary, auditing line organizational activities, determining the effectiveness of control measures employed, and providing such necessary routine services as film badge monitoring in the radiation control and reporting programs. Since radiation protection at the Oak Ridge Gaseous Diffusion Plant is appropriately considered as only one phase of the overall radiation protection program, it has been both efficient and practicable to include the basic staff radiation protection responsibility in a group which also has similar responsibilities for other parts of the plant safety program. In addition, certain activities closely related to radiation protection are provided by such service groups as those in the analytical laboratory, engineering, and maintenance organizations. The section of this review headed ESTIMATED COSTS OF RADIATION

PROTECTION lists the numbers of plant personnel involved in these major radiation protection activities. This listing actually reflects in each case an equivalent categorization of the personnel in a larger group, the members of which also have additional responsibilities.

2. Determinations of Exposures and Potential Exposures

a. External Radiation

All employees whose work may be expected to bring them into contact with external penetrating radiation are issued film badges which are read and evaluated on an appropriate schedule, currently monthly. In addition, "visitor" badges are available for other personnel who may enter these locations, and their use required; these are read at the termination of the visit. In general, regular badges are issued where any potential exposure for a period of as long as a month is anticipated.

b. Internal Exposures

Employees working in locations where exposure to air-borne radioactive materials is possible are given periodic urinalyses both to check the adequacy of control activities and to evaluate the possibility that internal exposures are occurring; similar checks are made after any indicated exposure resulting from material releases or other sources.

c. Environmental Checks

The air in locations subject to significant contamination by uranium or other radioactive materials is routinely and continuously monitored on a shift-length basis. In addition, short-term samples are made for specific jobs and as a part of routine audit and inspection activities in various plant locations. Measurements of alpha-activity upon floors and various work surfaces are made to evaluate any changes in radiation problems in the various locations concerned and to determine the effectiveness of control measures. Similarly, audit inspections may include checks of employee hands, clothing, tools, etc., as well as office facilities and similar locations. A continuing check is also maintained by the production plants upon the small quantities of uranium or other radioactive materials released to the plant streams and atmosphere.

3. Radiation Protection Activities

a. Engineering Design

Since many types of radiation protection requirements can be efficiently incorporated into equipment and facilities only during construction, the ORGDP specifically considers the shielding, ventilation, and other controls necessary to meet applicable permissible limits as a basic part of design activities.

It is recognized that a clean working environment and confinement of material are prime requisites for preventing possible exposure to such alpha-emitting material as uranium, the primary radionuclide of concern at the ORGDP. Thus, it is plant policy to so design equipment and specify its operation that contaminating materials will be as well confined as practicable, and that there be no part of the operation or location where material continuously escapes into an unconfined region to an extent that the maximum permissible concentrations in the environment will be exceeded. Similarly, where beta-gamma penetrating radiation is a consideration, the necessary shielding is also incorporated in the design. In all cases, maintenance requirements are also considered in the design.

b. Personnel Protection

Where it is not practicable to maintain air-borne or surface contamination below the points at which they may represent appreciable sources of exposure, items of protective equipment are furnished the employee as needed and he is required to use them. The most important of these personnel protection items are gas masks and respirators which are made available where contamination of the air is considered to present a problem; the use of these items is required as conditions warrant. In some cases where respiratory protection is necessary, the use of some items of company clothing may also be required.

c. Personal Hygiene

Adequate facilities for good personal hygiene are furnished, and instruments are provided to enable the employee to determine if his hands and clothing are above the permissible limits. Personnel hand checks may be made mandatory before eating, smoking, or shift change. Where contamination is below a point considered to represent an appreciable hazard, the devices and items noted above may also be provided on optional bases to those employees who desire them.

d. Use of Radiation Detection Instruments

It is plant policy to identify contaminated articles or areas and to separate such articles and areas as well as practicable. Adequate radiation detection instruments are made available to the line organization to aid them in identifying contaminated articles and areas and to provide them with a means for measuring the extent of the environmental contamination.

e. Audit Program

Members of the staff groups periodically review actual plant practices and activities, evaluate them from the viewpoint of radiation protection, and provide reports for appropriate levels of management concerning their findings and the meaning thereof. Such evaluations, of course, include the comparison of measurements made to the maximum permissible limits or to applicable control values.

f. Education

Technical and administrative information concerning the radiation protection aspects of the specific plant activities has been prepared and made available to plant personnel in accord with their requirements as necessary and appropriate. This has been supplemented by periodic training programs designed to insure that employees were aware of the radiation protection requirements of their specific jobs, including such items as protective equipment, applicable limits, and detection methods.

EXPERIENCE - 1959

1. External Personnel Exposure

   a. Greater than 3 rem/quarter, 12 rem/year, or 5 rem/year - None.

   b. Greater than 1 rem/month - 5. Action taken - As described.

2. Internal Personnel Exposure Possibilities

   a. Air Contamination

      1) Average air activity greater than the maximum permissible limit for 8 hours - 1471 (These comprise 12% of the total shift-length samples obtained, these being taken in the

areas having the principal possibilities of air contamination. Periodic short-term samples taken in other plant locations continue to indicate that potential exposures in locations other than those continuously sampled have negligible possibilities of any air activity, much less such activity at the permissible limit.)

2) Action Taken - Engineering design to confine material; short-term usage of respiratory protection by personnel as necessary. (Practically all of these samples resulted from "averaging" into the shift-length samples those short periods of comparatively high level activity originating from systems opened for maintenance; respiratory protection is used during these short periods.)

b. Water Activity

1) At no time did the peak activity in the potable water supply exceed the long-term maximum permissible concentrations specified for the radionuclides of interest for as short a time as the one-week sampling period. The intake water averaged some 0.99% of the occupational MPC for the year for these radionuclides.

c. Urinalysis and Clinical Data

1) At no time has there been any clinical evidence of personnel injury as a result of exposure to uranium materials.

2) Urinalysis results greater than those given in STANDARDS USED, Parts 3.d.1)-a) and -b) - None.

3) Urinalysis results greater than that given in STANDARDS USED, Part 3.d.1)-c) - 73.

4) Action Taken - Employees were removed from exposure or potential exposure to uranium materials for an average period of 20 days.

d. Surface Contamination

1) Only 1.2% of the total surface area had average contamination as high as 0.3 dis./min./cm.^{2}.

2) Only 5 locations involving some 46,910 ft.^{2} of area had average surface activities of as much as 30 dis./min./cm.^{2} for periods of as short as 3 months.

3) Action Taken - As described, this including cleanup, engineering design, and personnel protection.

e. Clothing Contamination

1) Surface activities above control point - None.

3. Waste Disposal

a. Water release at the plant boundaries above the long-term maximum permissible concentrations for as short times as the weekly sampling period - None. Average release level for the year was some 0.01% of the maximum permissible concentration for discharge of natural uranium.

b. Mud in stream bottoms - Showed no significant difference from that of the background mud in one of the TVA basins.

ESTIMATED COSTS OF RADIATION PROTECTION

1. Basic Costs

Staff Groups	- 11 Personnel	- $110,000
Laboratory Analysis	- 4 Personnel	- 40,000
Instrument Engineering and Maintenance	- 5 Personnel	- 50,000
Instruments		- 20,000
	Total:	$220,000

2. The $220,000 basic operating cost of the ORGDP radiation protection program represents an expenditure of approximately $5 per plant employee or 0.2% of the plant operating expense. The figures given in Part 1 include support costs of the respective staff and service functions noted, the limited experimental and development work carried on at the ORGDP, and the operating costs of the plant film badge program.

3. The figures of Part 1 do not include the increased capital costs of equipment and facilities resulting from radiation protection considerations. They also do not include costs such as those involved in the provision and use of protective equipment, emergency preparations, engineering design, the removal of radioactive contamination from various surfaces, or the radiation monitoring done by operations employees as a relatively small part of their normal jobs. The costs of various "fringe benefit" items, such as employee wash-up time or clothing change time, which are ostensibly based on radiation protection but in reality have only minimal effects upon such protection are also omitted; these costs alone may easily be greater than those noted in Part 1 as the general direct program expense.

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Item #3

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J. Lamb / 1034A

Requestor / Document Center (is requested to provide the following document)

Date of request ~~[illegible]~~ ~~[illegible]~~ 6/14/96 Expected receipt of document ~~[illegible]~~ 7/14/96

Document number ______ Date of document 1960

Title and author (if document is unnumbered) (7 items)

Radiation Protection Criteria and Standards: Use at UCC Facilities.

⇒ Copy marked documents

(This section to be completed by Document Center)

Date request received 6/19/96

Date submitted to ADC 7/11/96

Date submitted to HSA Coordinator 6/19/96

(This section to be completed by HSA Coordinator)

Date submitted to CICO 7/11/96

Date received from CICO ______

Date submitted to ChemRisk/Shonka and DOE 7/30/96

(This section to be completed by ChemRisk/Shonka Research Associates, Inc.)

Date document received ______

Signature ______

CC: Jennifer Lamb

CC: Steve Wiley
Linda Hill
See release 7/11/96

cc w/enc: Linda Hill - Item 1

Steve Wiley - Item 5; Item 2 which contains multisite information must be reviewed for classification by K-25 and ORNL, PGDP, and Y-12--Y-12 will be responsible for release of document after all classification reviews are completed

Sheila Thornton - Items 4, 6, and 7

Sheila Thornton - Item 3 (PGDP document to be sent to PGDP for release)

cc: Jennifer Lamb - For your information

Item 1 - ORNL Document

Item 2 - Y-12 Document which contains multisite information requiring classification review by K-25, ORNL, PGDP, and Y-12

Item 3 - PGDP Document

Item 4 - K-25 Document

Item 5 - Y-12 Document

Item 6 - K-25 Document

Item 7 - K-25 Document

SG Thornton
7/11/96

RADIATION PROTECTION CRITERIA AND STANDARDS:
THEIR BASIS AND USE

PLANT OPERATIONS

The Paducah Plant is a government-owned gaseous diffusion plant operated by Union Carbide Nuclear Company for the Atomic Energy Commission. The diffusion plant, with the associated uranium hexafluoride manufacturing plant and uranium metal foundry, processes large quantities of relatively pure uranium compounds. The major sources of external penetrating radiation from such materials are the daughter products, isotopes of thorium and protactinium, formed by the alpha decay of the parent uranium, and which are concentrated in the ash produced during the fluorination process. The element uranium ~~may prove~~ can be hazardous only if allowed to enter the body. The chemical toxicity of the uranium materials processed at the Paducah Plant overshadows any radiation danger from this element, thus making it comparable as an industrial risk to lead, mercury, or other well known heavy metals.

RADIATION STANDARDS OBSERVED

Basic Standards

The radiation standards recognized at the Paducah Plant are those documented in NBS Handbooks 59 and 69, including the addendum to the former.

Thus, for external penetrating radiation the basic standards observed are the 13-week limits of 3 rems of gamma radiation to the body and 6 rems of beta radiation to the skin. The added restriction is imposed for gamma radiation that no employee shall exceed an accumulated dose greater than (N-18) x 5 rems where N is his age in years, with a comparable restriction for cumulative exposure to the skin from radiation of low penetrating power (beta) being (N-18) x 10 rems.

For internal deposits of uranium, the limiting quantity is considered to be the 0.005 microcuries listed in NBS Handbook 69 as the maximum permissible body burden when the kidney is considered as the critical organ. The maximum permissible con-

C. L. Young 7-17-96

centration observed for uranium in air for plant work areas is 6×10^{-11} microcuries per cubic centimeter of air.

<u>Action or Control Limits</u>

It has been the plant policy to observe action points at some fraction of nationally recognized standards to insure against any employee exceeding the established limits. Thus, for penetrating radiation any employee whose total exposure reaches either 2.4 rem of gamma radiation or 4.8 rem of beta radiation within a 13-week period is rotated to a job having no radiation exposure until such time as the exposure quarter has ended. Such job rotation has continued to ~~been extended~~ all employees in various Groups wi~~thin the past year~~ so that the probability of any employee exceeding even the action levels has been greatly reduced.

While it may be calculated from the maximum permissible body burden for uranium, and the various factors for the distribution of and excretion from this body burden, that an excretion rate of approximately 50 micrograms per day may be considered indicative of a significant internal body deposition ~~maximum permissible body burden~~ of normal uranium, the plant action point is set at 12 micrograms per day. When a series of urinalyses indicate an employee is excreting more than 12 micrograms of uranium per day, he is removed from further uranium exposure until such time as his excretion rate is below this level.

OPERATING METHODS

<u>Plant Personnel</u>

The basic philosophy of the Paducah Plant is that each member of the line organization has a responsibility for the safety and health of employees commensurate with his responsibility for the operation of the plant. The operating groups have radiation detection instruments and have been trained in the use of such equipment. They have the responsibility for the maintenance of ventilating equipment, both general area and local exhaust, as well as that of keeping operating equipment in such condition that the need for such ventilation will be minimal. The responsibilities of using the proper protective equipment, of maintaining a clean work area, and of rotating personnel to different jobs or work areas as needed to comply with plant radiation and uranium action points are all that of line supervision.

The Medical and the Health Physics and Hygiene Departments are maintained as staff groups, equipped to provide technical information and assistance as required. The functions served include making inspections of all areas and all operations, maintaining a film meter service, coordinating a bio-assay program, monitoring of workroom air for many chemicals used as well as for uranium, making audit surveys of the radiation levels for various jobs or work areas, conducting an environmental monitoring program to assure that no damage may result to adjacent communities or individuals and to provide protection in the case of unwarranted litigation, providing a periodic and special health examination schedule, and assisting in the training of all employees.

A total of seven employees work in the Health Physics and Hygiene Department, comprising approximately 0.4% of the plant work force. In addition There are 16 employees in the plant Medical Department.

In addition to the above groups there are various service groups which provide specialized engineering, chemical and radiochemical laboratory, and maintenance functions. None of these people work exclusively in radiation protection, but many spend a very significant portion of their time in such endeavor. There are 3 to 4) analyst days spent each day on laboratory analyses directly involved in radiation protection.

Plant Design

The basic method employed to control exposure to uranium is the confinement of the material being processed. All diffusion plant equipment is designed so the UF_6 is pumped through the miles of piping, and other essential associated diffusion plant equipment, with the probability of the exposure of any employee being reduced to insignificance. However, the system must occasionally be opened for maintenance, and the product and tails material must be withdrawn into appropriate containers.

[ ] to minimize

At such times, the possibility of some small amount of the material becoming air-borne ~~is increased, and~~ [the necessary precautionary measures are followed.] (3)

Essentially the same rules apply in the uranium hexafluoride manufacturing portion of the plant. [~~The greater frequency with which some of this equipment must be entered for maintenance work also elevates the likelihood of some escape of uranium materials from that equipment.~~ To compensate ~~for this~~ where greater use is made ~~here~~ of local ventilation exhausting through filters designed to prevent the escape of the uranium. Elim (4) ?

Routine inspections are made of all equipment to detect any conditions which require remedial action. Such inspections are performed daily by line supervision and their employees, and on a less frequent basis by members of the Health Physics and Hygiene Department.

Assessment of Exposure

A routine film badge program is maintained such that each employee having a significant probability of exposure to penetrating radiation wears a film meter which is collected, developed, read and evaluated on a monthly cycle. Currently, approximately one-third of the plant population ~~are~~ is included in this program. ~~however, all plant employees will be badged in the near future when a new combination security-film badge is delivered from the company which received the contract for the fabrication of them. This will be one step in a program designed to give complete coverage of employees so that exposures may be evaluated more rapidly and accurately in any future unscheduled critical reaction.~~ 15

Employees whose work involves any possibility of exposure to uranium are scheduled for urinalysis at a frequency which is determined by their job exposure probability. The frequency of such schedule may vary from a weekly one for an employee whose recent urinalyses have indicated an excretion rate approaching the plant control limit to an annual one for an indivudual who works in an area where no uranium should be encountered.

Continuous air samplers operate in all areas where an audit of the airborne uranium has indicated a need for such. The samplers collect onto a filter paper the particulate matter from air which is sampled over an 8-hour work shift. The filter paper is then alpha counted in a laboratory type instrument to determine the airborne uranium concentration. New equipment or jobs, or any changes in operating procedures on existing jobs, are checked by an inspection which includes an evaluation of air samples collected in the breathing zone of employees and in the general work location.

~~The problem of~~ Airborne beta-gamma active decay products of uranium ~~is~~ are controlled by maintaining the alpha activity of uranium within acceptable limits, but such air samples are less frequently counted for beta-gamma activity as an added precaution. Checks are also made of such trace impurities as fission products and transuranic elements to evaluate and eliminate any possible hazard from an unexpected accumulation of such materials. (6)

PLANT EXPERIENCE

The effectiveness of any program may be assessed by the results produced. During the year of 1959 there were 7 plant employees who were temporarily rotated to jobs involving no radiation exposure, but none of these exceeded the recognized quarterly limits. In the same year a total of 66 employees were temporarily rotated to jobs having no contact with uranium, but none of these over a period of six months averaged an excretion rate indicative of half the maximum permissible body burden.

The monitoring of plant areas for radioactive contamination has shown that most work is done in an environment which is maintained well below the maximum permissible concentration for airborne uranium. There are jobs which produce localized areas of somewhat elevated concentrations of uranium in air for short periods of time, but as new operating techniques are developed these events occur less frequently. The mean of 8810 shift-length air samples collected in work areas during 1959 was

2.04×10^{-11} microcuries of alpha activity per cubic centimeter of air; this represents 34% of the maximum permissible concentration of 6×10^{-11} $\mu c/cc$.

COSTS OF RADIATION PROTECTION PROGRAM

It is rather difficult to evaluate the cost of radiation protection in a plant in which the basic responsibility for such protection reverts to line supervision, and still exclude the costs incurred from the efforts of ~~that group~~ the operating personnel. The annual budget for the Health Physics Department for FY-1960 is approximately $65,000, or about 0.3% of the operating expense for the plant, exclusive of power costs.

In addition to this basic cost, other items such as the maintenance of radiation instruments which belong to other groups, maintenance of local exhaust ventilation, and the cost of maintaining respirators and masks might also be included. These activities will approximately equal the cost of the Health Physics budget.

PROTECTION OF ENVIRONS

Even normal uranium at $11.45 per pound is a rather expensive element; so this represents a great incentive to recover as much in any situation as is economically feasible. The added desire to maintain a wholesome relationship with neighboring communities and individuals makes it essential that all waste air be exhausted through filters, and that all effluent waters be maintained at extremely low concentrations of uranium.

The results of the plant environmental monitoring program for 1959 indicate that the average of 3×10^{-13} microcuries of uranium per cubic centimeter of air at the perimeter fence is below NBS Handbook 69 standards for air beyond control areas by a factor of 10. The mean result for beta activity, 2×10^{-12} microcuries per cubic centimeter of air, is a factor of 500 below the applicable standard.

The monitoring of water in the small, wet weather streams on each side of the plant during 1959 gave an average alpha activity of 1.07×10^{-7} microcuries per cubic centimeter and a mean beta analysis of 2.88×10^{-6} $\mu c/cc$. These figures are approximately factors of 200 and 10, respectively, below the standards recommended for water beyond a restricted area. Samples collected in the Ohio River below this plant show no greater alpha activity than samples collected above the plant in that river. The beta activity of 2.23×10^{-7} μc/cc, while slightly elevated above the upstream results, is a factor of approximately 100 below the standard listed in NBS Handbook 69.

EFFECTS OF POSSIBLE CHANGES IN LIMITS

In the eight years of operations at the Paducah Plant the accumulation of internal deposits of uranium by employees has been minimal, and exposures to penetrating radiation have been less than the maximum figures accepted nationally. There has been no clinical evidence of ~~injury,~~ either acute or chronic, to any employee from radiation or radioactive materials. [~~However, as with employment in any industry, there may remain some remote possibility of injury. The question remains as to what extent one should go in attempting to reduce~~ such exposures to zero.] ? (7)

It has been estimated that if standards were reduced to 50% of the current values, an expenditure of approximately $2,000,000 might be necessary. This would ~~to~~ provide ~~either~~ a method for doing much maintenance and handling of material by remote control such as that utilized around nuclear reactors and in the processing of ~~the more hazardous~~ plutonium, [~~in reducing the frequency for the need of handling such materials or performing maintenance on such equipment~~.] (8) If the present radiation standards were to be reduced by a factor of 5 or 10, however, the ramifications would be numerous. A cost vs. result relationship which might be nearly linear if radiation limits were reduced by a factor of 2, would probably more nearly be exponential at the factor of 10. Thus, costs with and difficulties in meeting limits would increase much more rapidly than would the desired reduction in radiation exposure. In addition to the initial expense involved, and increased operating cost, such changes could also result i~~t would be necessary to employ more people to rotate so the exposure per person could be reduced. Thus, the continuing expense of an increased annual payroll would result.~~ employees being required to use respiratory equipment and other protective devices for extended periods rather than for specific short-term jobs as is now the case. The reduction of the maximum permissible concentration of some isotopes would reduce these levels below those which can be measured today.

Conversely, if such standards were to be raised by 50% of the present values, it would be possible to save some of the money being expended to control exposures.

The accumulation of evidence over the past 8 years at the Paducah Plant, and the past 15 years at other plants operated by Union Carbide Nuclear Company in this industry, shows that standards are being met, and there seems to be no evidence that anyone has suffered damage at these levels.

EGB:mlp
4-12-60

MARTIN MARIETTA

MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2009
OAK RIDGE, TENNESSEE 37831

July 24, 1996

Ms. J. K. Lamb
ChemRisk
1135 Atlantic Avenue
Alameda, California 94501

Dear Ms. Lamb:

Documents Requested by ChemRisk - Health Studies Agreement

Enclosed are copies of three documents which you have requested during your search through the K-1034A Site Records Center. These documents have not previously been submitted for review and approval for public release. The Y-12 Plant Classification and Technical Information Offices have reviewed them and have determined that they do not contain classified or controlled information.

Y/TS-1552	Moore, W. C., "Information on Radioactive Waste Disposal and Storage at Y-12 (Box # NN-78-07-2.1.3A)," Union Carbide Nuclear Company, Y-12 Plant (April 14, 1958).
Y/TS-1553	Murray, J. P., "Request for Toxicological Information (Box # NN-17-2 (#1) 2.1.1)," Union Carbide Nuclear Company, Y-12 Plant (January 26, 1959).
Y/TS-1554	Author not shown, "Radiation Protection Criteria and Standards: Use at UCC Facilities (Box # 11-4-1)," Union Carbide Nuclear Company, Y-12 Plant (1960).

If you have any questions, please contact L. L. McCauley at (423) 574-7593 or S. W. Wiley at (423) 576-0263.

Very truly yours,

L L McCauley

for R. M. Keyser, Director
Health, Safety, Environment,
and Accountability Organization

RMK:djl

Enclosures: As Stated

c/encs: A. L. Rothrock, DOE-ORO
S. W. Wiley (RC)

c:

T. R. Butz	R. M. Keyser
C. D. Goins, Jr	L. L. McCauley
F. P. Gustavson	S. D. Morris, DOE-ORO
T. W. Joseph, DOE-ORO	R. J. Spence, DOE-ORO

ChemRisk 7/23

DOCUMENT DESCRIPTION (Completed By Requesting Division)

Document No.	Author's Telephone No.	Acct. No.	Date of Request
Y/TS-1552	6-0263	2366000 $	7/16/96

Unclassified Title: INFORMATION ON RADIOACTIVE WASTE DISPOSAL AND STORAGE AT Y-12 (K-1034A # NN-78-07-2.1 3A)

Author(s) Requestor: Steve Wiley

TYPE: ☐ Formal Report ☐ Informal Report ☐ Progress/Status Report ☐ Co-Op Report ☐ Thesis/Term Paper

☐ Oral Presentation (identify meeting, sponsor, location, date):

☐ Journal Article (Identify Journal):

☒ Other (Specify): To Be Released to ChemRisk, Phase II

Document will be published in proceedings ☒ No ☐ Yes

Document will be distributed at meeting ☒ No ☐ Yes

Document has patent or invention significance ☐ No ☐ Yes (Identify)

Document has been previously released ☒ No ☐ Yes (Reference)

DIVISION REVIEW AND APPROVAL (Completed By Requesting Division)

TECHNICAL CLASSIFICATION REVIEW (Divisional Classification Representative)

Title(s): U Abstract: NA

DOCUMENT: Level U Category –

Signature: R J Fraser Date: 7/18/96

DOCUMENT REQUEST APPROVED (Division or Department)

Signature: [signature] Date: 7/16/96

Signature: Date:

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M-3679 Category

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Distribution: UCN-7721B DOE F-1332.15 Document

Y-12 Central Files Y-12 RC Y-12 RC Y-12 RC

TIO File L.L. McCauley

S.W. Wiley

R.M. Keyser

Distribution Remarks: Unlimited (ChemRisk)

APPROVAL AND RELEASE

Date Received

Date Initiated 7/16/96

☒ CLASSIFICATIONS:

Title(s): Unclassified Abstract –

DOCUMENT:

Level Unclassified Category –

Weapons Data Sigma –

R. F. [signature] 18 July 1996

Y-12 Classification Office Date

☐ Editor Date

☒ Patent Office [signature] Date

☐ Date

☐ Date

APPROVED FOR: ☐ Declassification ☐ Release subject to use of the following admonitory markings and conditions:

☐ Disclaimer ☐ Copyright ☐ Patent Caution ☐ Other

[signature] 7/22/96

Technical Information Office Date

Conditions/Remarks:

From: Box NN-78-07 2.1.3A Y-12 Plant

ChemRisk/Shonka Research Associates, Inc., Document Request Form

(This section to be completed by subcontractor requesting document)

J. Lamb / 1034A

Requestor / Document Center (is requested to provide the following document)

Date of request ~~[illegible]~~ 6/14/96 Expected receipt of document ~~[illegible]~~ 7/14/96

Document number ~~8~~ none Date of document 4/14/58

Title and author (if document is unnumbered)

Information on Radioactive Waste Disposal and Storage at Y-12

(This section to be completed by Document Center)

Date request received 6/19/96

Date submitted to ADC 7/3/96

Date submitted to HSA Coordinator 6/19/96

(This section to be completed by HSA Coordinator)

Date submitted to CICO 7/3/96

Date received from CICO

Date submitted to ChemRisk/Shonka and DOE

(This section to be completed by ChemRisk/Shonka Research Associates, Inc.)

Date document received

Signature

CC: Jennifer Lamb

CC: Steve Wiley
Y-12 document for processing
L Thornton
7/11/96

① Jenkins
② Lang

INTER-COMPANY CORRESPONDENCE

UNION CARBIDE NUCLEAR COMPANY

A Division of Union Carbide and Carbon Corporation

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To: Those Listed

Copies To:

Plant: Y-12

Date: April 14, 1958

Subject: Information on Radioactive Waste Disposal and Storage at Y-12

Public hearings on industrial radioactive waste disposal problems are scheduled before a special subcommittee of the Joint Committee on Atomic Energy in Washington, D. C. from April 28 through May 6, 1958.

With regard to this matter, the Commission has requested that UCNC supply pertinent information. The K-25 Technical Division is coordinating a joint reply covering the Y-12, K-25, and Paducah Plants. Y-12 data submitted in response to this request is a compilation of information prepared jointly by the Y-12 Health Physics Department, Chemical Division, Maintenance Division, Finance and Materials Division, and Process Analysis Department.

Attached are Exhibit "A", an outline of the operational methods and procedures used in the collection, handling, processing and disposal of waste materials at Y-12; Exhibit "B", a statement of the amount of uranium oxide, etc., depleted in U-235 stored in Y-12; Table I, a cost summary of Y-12 Plant waste disposal activities; and Maps "A", "B", and "C", Y-12 environmental monitoring stations and radioactive waste disposal areas.

W. C. Moore
W. C. Moore

ACA:ob

Attachments (6)

Distribution:

E. C. Ellis
W. E. Heckert
R. F. Hibbs
D. M. Lang
J. D. McLendon
W. C. Moore
J. P. Murray
F. S. Patton (Y-12RC)
J. L. Waters
W. K. Whitson, Jr.
G. A. Strasser

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7/22/96
Technical Information Office Date

WCX-163 (8-55)

This form for Inter-Company Correspondence only

EXHIBIT "A"

Y-12 WASTE MANAGEMENT OPERATION

I. The description of the radioactive waste management operation at the Y-12 Plant will be divided into a brief discussion of certain individual phases of this operation, viz., waste generation, waste handling, waste processing, waste disposal and environmental monitoring.

II. Wastes generated at Y-12 may be classified into two types, liquid and solid.

A. Liquid wastes consist of fluid masses of material containing small concentrations of uranium whose recovery is not deemed economically feasible. Examples of this type of waste are spent process solutions.

B. Solid wastes consist of process residues whose uranium content does not economically warrant further processing and used processing equipment and supplies which are contaminated.

III. The handling of radioactive wastes is accomplished according to their type.

A. Liquid wastes are either pumped through pipelines or transported in tank trucks to the disposal areas.

B. Solid wastes are hauled either in drums or carrying receptacles to disposal areas.

IV. Waste processing at Y-12 is performed to recover uranium from the residues or reduce the level of radioactivity of used processing equipment and supplies so that these may be safely sold for their salvage value. Processing is not performed merely to reduce the volume or radioactivity of the waste prior to storage or disposal.

V. The final disposal of radioactive wastes is effected according to the following scheme.

A. Liquid wastes are released into either the East Fork of Poplar Creek or the settling basins west of Y-12. (See Map A).

1. Those emptied into the industrial sewers are fed into the East Fork of Poplar Creek. The alpha activity of these liquids is less than 6×10^{-4} microcuries per milliliter.

2. The remainder of the liquid wastes are discharged into the settling basins. The alpha activity of this liquid is less than 7×10^{-2} microcuries per milliliter.

B. Solid wastes are routed to the contaminated oxide storage areas (See Map A), the decontamination and smelting area (See Map A), the Y-12 burning ground (See Map B), the Y-12 burial ground (See Map B), or the ORNL burial ground.

1. Certain process residues which are designated as contaminated oxides are stored in 30-gallon black iron barrels at the contaminated oxide storage area. The alpha activity of this oxide ranges from

.30 to .45 microcuries per gram.

2. Used contaminated equipment is sold through surplus outlets with levels as high as 2,000 alpha disintegrations per minute per 100 square centimeters and 0.3 mrad/hour beta-gamma.* Frequently, the equipment is decontaminated to meet these standards. Certain types of metal scrap contaminated to average levels as high as 5,000 alpha disintegrations per minute per 100 square centimeters and the beta-gamma that would accompany uranium surface contamination of this magnitude can also be sold through surplus outlets. Metals contaminated in excess of the limits above are decontaminated by smelting.

3. Contaminated combustible solid wastes having an alpha activity less than 10,000 disintegrations per minute over 100 square centimeters of surface area are sent to the burning ground.

4. Contaminated solid wastes having alpha activity less than 7×10^{-2} microcuries per gram are sent to the Y-12 burial ground.

5. Contaminated wastes known to contain plutonium, thorium or alpha activity greater than 7×10^{-2} microcuries per gram are sent to the ORNL burial ground.

VI. Monitoring of the level of radioactivity in the environs of the Y-12 operating and disposal areas is effected by analysis of samples collected at several points.

A. Air sampling is accomplished by three sampling stations located near the center of the Y-12 valley (See Map A) which operate on a twenty-four-hour-per-day, seven-day-per-week basis. The prevailing winds of the area usually blow from the uranium processing areas toward these three stations, all of which detect alpha radiation and two of which detect beta radiation. The radioactivity levels of these samples have consistently been less than one-third of the maximum level suggested for non occupational exposure to airborne uranium by the National Committee on Radiation Protection and Measurement in NBS Handbook 52.

B. Water sampling is performed by taking check samples from the East Fork of Poplar Creek and Bear Creek. (See Maps A and C). The sample from Poplar Creek is a weekly sample constituted by mixing daily samples; the one from Bear Creek is a weekly spot sample. Both these samples are analyzed for alpha and beta radiation. The radioactivity levels of these samples have consistently been less than one-tenth of the maximum level suggested for uranium in drinking water for non occupational exposure by the National Committee on Radiation Protection and Measurement in NBS Handbook 52.

* Standard Practice Procedure, Union Carbide Nuclear Company, D-2-5, October 24, 1957.

EXHIBIT "B"

Approximately one million pounds of uranium depleted in U-235 is stored at Building 81-22. This uranium is principally in the form of uranium oxide stored in 30 gallon containers. The recovery of the contained uranium at this time is not considered economically feasible.

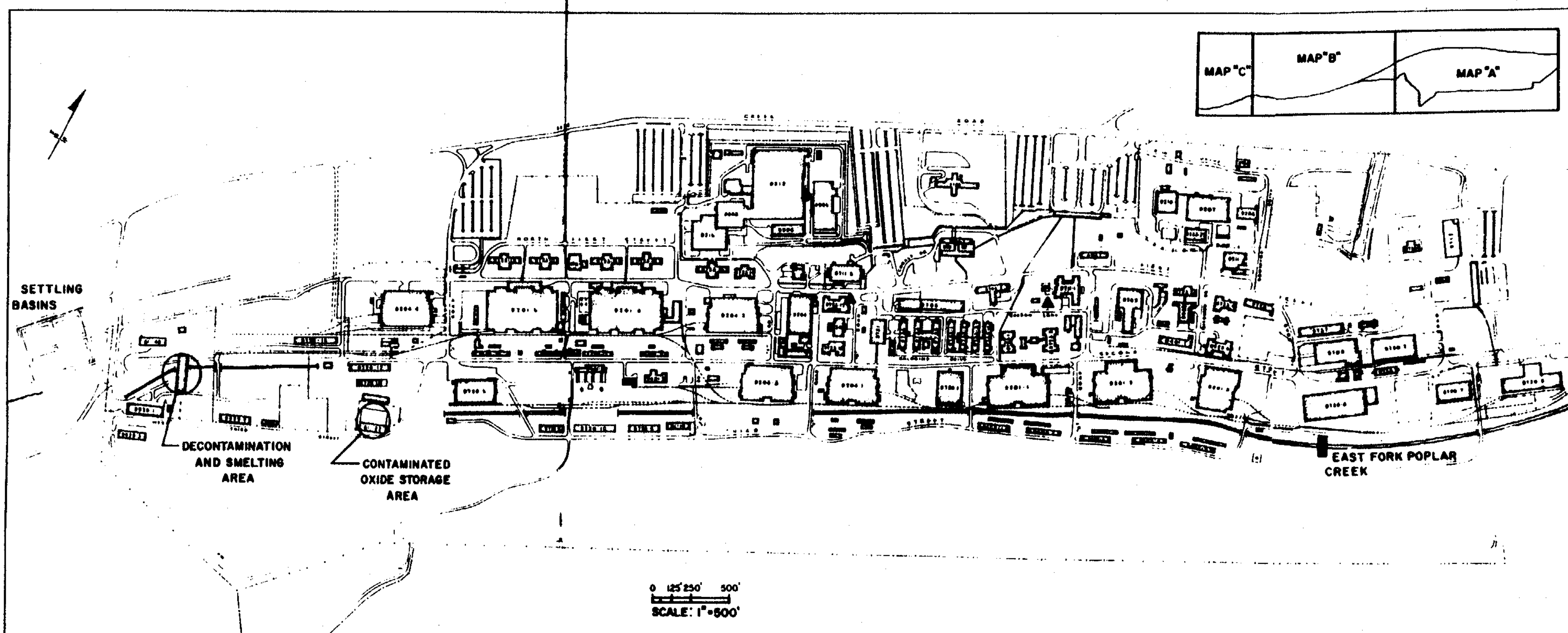
TABLE I

COST SUMMARY OF Y-12 PLANT WASTE DISPOSAL ACTIVITIES

	LIQUID WASTE DISPOSAL Pipeline and Settling Basins	SOLID WASTE DISPOSAL Y-12 Burning Ground Y-12 Burial Ground ORNL Burial Ground Building 81-22 Storage	WASTE MONITORING FACILITIES	TOTAL
Total Capital Costs	$67,000	$90,000*	$7,000	$164,000
Annual Operating Costs	63,000	40,000**	4,000	107,000
Annual Maintenance Costs	4,000	3,000	1,000	8,000
Total Annual Operating and Maintenance Costs	67,000	43,000	5,000	115,000
Annual Manpower Requirements				
Administrative	.40 man yr.	1 man yr.	.03 man yr.	1.43 man yr.
Technical	.05	1	.01	1.06
Operating	4.00	5	.25	9.25
Total	4.45 man yr.	7 man yr.	.29 man yr.	11.74 man yr.

* This includes $20,000 which represents approximately 40% of the present value of Building 81-22 used for contaminated oxide storage and $10,000 for approximately 2000 barrels used as storage containers.

** This includes approximately $1700 for burial at ORNL Burial Ground of approximately 100 loads per year of radioactive waste from the smelter located in the Y-12 Area and $1000 for transportation of contaminated oxide to Building 81-22 and handling of this material at Building 81-22.



UNION CARBIDE NUCLEAR COMPANY

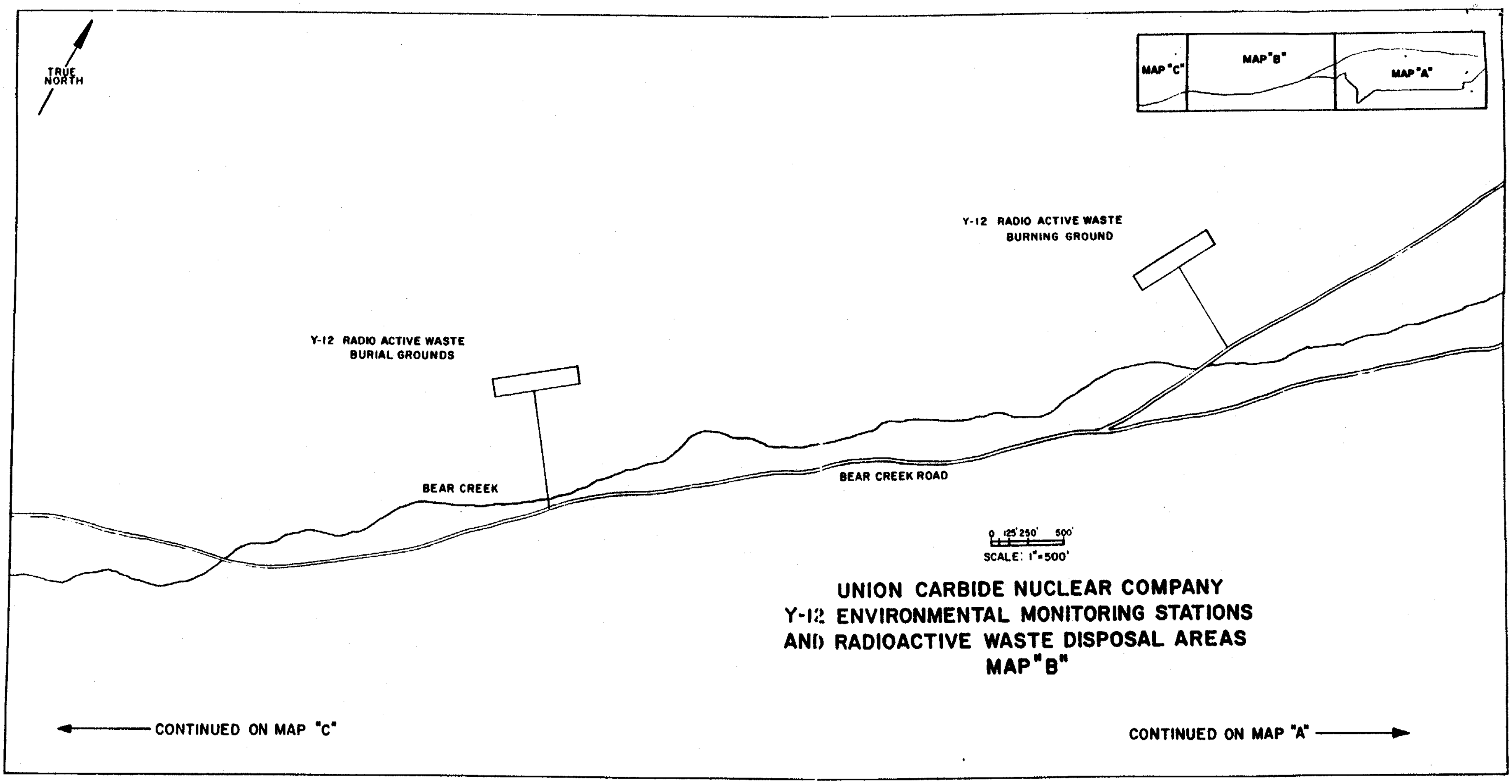
Y-12 ENVIRONMENTAL MONITORING STATIONS AND RADIOACTIVE WASTE DISPOSAL AREAS

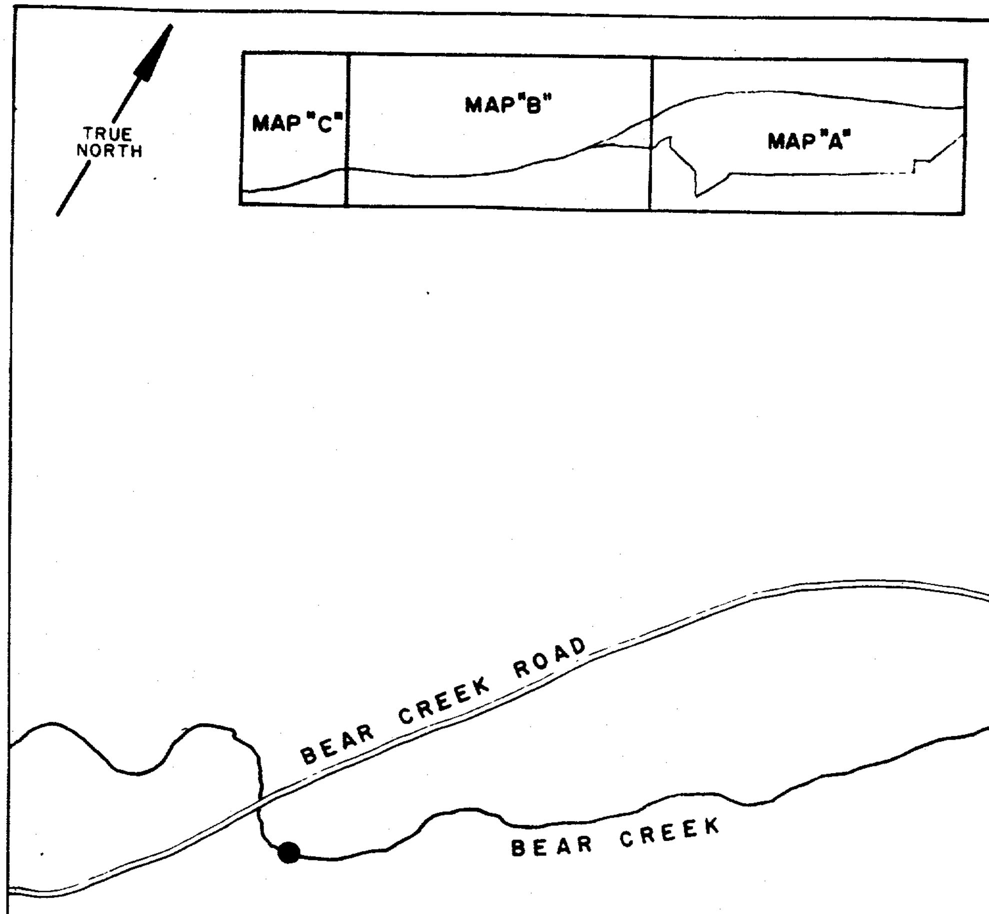
MAP "A"

▲ GENERAL AIR SAMPLERS

▮ COLLECTION POINT OF WEEKLY COMPOSITE WATER SAMPLE FOR ALPHA AND BETA

← CONTINUED ON MAP "B"


TRUE NORTH
MAP "C"
MAP "B"
MAP "A"
Y-12 RADIO ACTIVE WASTE BURNING GROUND
Y-12 RADIO ACTIVE WASTE BURIAL GROUNDS
BEAR CREEK
BEAR CREEK ROAD
0 125' 250' 500'
SCALE: 1" = 500'
UNION CARBIDE NUCLEAR COMPANY
Y-12 ENVIRONMENTAL MONITORING STATIONS
AND RADIOACTIVE WASTE DISPOSAL AREAS
MAP "B"
CONTINUED ON MAP "C"
CONTINUED ON MAP "A"



● COLLECTION POINT OF WEEKLY SPOT WATER SAMPLE FOR ALPHA AND BETA

0 125' 250' 500'
SCALE: 1" = 500'

UNION CARBIDE NUCLEAR COMPANY
Y-12 ENVIRONMENTAL MONITORING STATIONS AND RADIOACTIVE WASTE DISPOSAL AREAS
MAP "C"

CONTINUED ON MAP "B" ⟶

ChemRisk 7/23

DOCUMENT DESCRIPTION (Completed By Requesting Division)

Document No.	Author's Telephone No.	Acct. No.	Date of Request
Y/TS-1553	6-0263	2366000 S	7/16/96

Unclassified Title: REQUEST FOR TOXICOLOGICAL INFORMATION (K-1034A #NN-17.2(#1)-2.1.1)

Author(s) Requestor: Steve Wiley

TYPE: ☐ Formal Report ☐ Informal Report ☐ Progress/Status Report ☐ Co-Op Report ☐ Thesis/Term Paper

☐ Oral Presentation (identify meeting, sponsor, location, date):

☐ Journal Article (Identify Journal):

☒ Other (Specify): To Be Released to ChemRisk, Phase II

Document will be published in proceedings ☑ No ☐ Yes

Document will be distributed at meeting ☑ No ☐ Yes

Document has patent or invention significance ☐ No ☐ Yes (Identify)

Document has been previously released ☑ No ☐ Yes (Reference)

DIVISION REVIEW AND APPROVAL (Completed By Requesting Division)

TECHNICAL CLASSIFICATION REVIEW (Divisional Classification Representative)

Title(s): U Abstract: NA

DOCUMENT: Level U Category —

R J Fraser (Signature) 7/18/96 (Date)

DOCUMENT REQUEST APPROVED (Division or Department)

S. W. Wiley (Signature) 7/16/96 (Date)

Signature Date

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Distribution: UCN-7721B DOE F-1332.15 Document

Y-12 Central Files Y-12 RC Y-12 RC Y-12 RC

TIO File

L.L. McCauley

S.W. Wiley

R.M. Keyser

Distribution Remarks: Unlimited (ChemRisk)

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Date Received

Date Initiated 7/16/96

☒ CLASSIFICATIONS

Title(s): Unclassified Abstract —

DOCUMENT:

Level Unclassified Category —

Weapons Data — Sigma —

R. E. Cruish (Y-12 Classification Office) 18 July 1996 (Date)

☐ Editor Date

☒ Patent Office Ward / [illegible] Date

☐ Date

☐ Date

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Technical Information Office 7/22/96 (Date)

Conditions/Remarks:

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ChemRisk/Shonka Research Associates, Inc., Document Request Form (1959)

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J. Lamb / 1034A

Requestor / Document Center (is requested to provide the following document)

Date of request ~~[illegible]~~ 6/14/96 Expected receipt of document ~~[illegible]~~ 7/14/96

Document number none Date of document 1) 1/29/59 2) 1/26/59

2 documents

Title and author (if document is unnumbered)

1) Request for Toxicological Information ORNL

2) Request for Toxicological Information - Y-12

=> copy marked document

(This section to be completed by Document Center)

Date request received 6/19/96

Date submitted to ADC 7/18/96

Date submitted to HSA Coordinator 6/19/96

(This section to be completed by HSA Coordinator)

Date submitted to CICO 7/18/96

Date received from CICO

Date submitted to ChemRisk/Shonka and DOE

(This section to be completed by ChemRisk/Shonka Research Associates, Inc.)

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Item 1 - CC: Linda Hill
ORNL Document for processing

Item 2 - CC: Steve Wiley
Y-12 Document for processing

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INTER-COMPANY CORRESPONDENCE

UNION CARBIDE NUCLEAR COMPANY

A Division of Union Carbide and Carbon Corporation

To: Mr. D. M. Lang
Building K-1005
ORGDP

Plant: Y-12

Date: January 26, 1959

Subject: Request for Toxicological Information

Copies To: C. E. Center
L. B. Emlet
R. F. Hibbs
A. P. Huber
R. G. Jordan
G. A. Strasser
C. R. Sullivan, Jr., M.D.
J. D. McLendon, Y12RC
File

To FRV/JHJ 1-8-58

Reference is made to a letter from Mr. S. R. Sapirie to Mr. C. E. Center, January 5, 1959, concerning a request for toxicological information relative to the period since January 1, 1957.

In the large complex which forms Y-12, an unusual number of highly technical and unique problems give rise to an equally unusual number of potential toxicological or radiological hazards. An indication of the scope of the overall problem may be found by referring to Report Y-1146, "Y-12 Facility Accident Prevention Audit", issued October 15, 1956.

Copy not in Plant; advise Levin if copy needed; will request fr Y-12 1-29

Few new problems have arisen since 1956. In the case of radiological hazards, no significant change has occurred as of this time. The following items, which present potential toxicological problems on more than a laboratory basis, have come into use in the last two years.

1. Beryllium Fluorides and Oxides

   Beryllium compounds have been processed prior to 1957, however, the scale of usage has increased considerably due to establishment of fabrication operations for the manufacture of reactor components and other classified items. The hazards associated with the handling and processing of these materials are in general those of inhalation and skin exposure (dermatitis). Usual precautions of containment, ventilation control, and protective equipment confines the hazard to the local environs.

2. Epoxy Resins (Amines)

C Industrial hygiene problems, inhalation and skin exposure, arise in the chemical preparation and physical forming of this material for weapons application. As in the case of beryllium, the problem is limited to the local area by appropriate engineering facilities and protective equipment.

3. Polyurethane Foam (Toluene Diisocyanate)

E Health hazards by inhalation during chemical preparation of components to finished parts are avoided by ~~the same general treatment as above~~. appropriate engineering fac and protective equipment

The number of people affected by the above operations would probably be small in all cases. In no case, short of a major catastrophe (high level explosion and/or fire), would the general public become involved.

It is to be noted that many toxic compounds, organic and inorganic, are used on a laboratory scale. No effort is made to list such items here.

J P Murray
J. P. Murray

7-0315

JDM:csm